CALIFORNIA DIVISION OF MINES AND GEOLOGY

FAULT EVALUATION REPORT FER-163

Buena Vista Fault, Kern County

by

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INTRODUCTION

The Buena Vista fault is located just north of Taft in the Taft 7.5-minute quadrangle (Figure 1). The Buena Vista fault and two unnamed faults have been documented as historically active and were zoned under the Alquist-Priolo Special Studies Zones Act in 1976 (California Division of Mines and Geology, 1976; Figure 2). The initial zoning was based on Wilt (1958) and Nason (1974). The latter reference, which is unpublished, was improperly cited as Nason and others (1974) on the 1976 SSZ map. Subsequent to zoning, a map by Manning (1973), reproduced herein as Figure 3, was discovered. Manning depicts one of the faults as extending outside the current SSZ. The purpose of this limited investigation is to determine whether Manning is correct, and whether the faults zoned meet the current zoning criteria of sufficiently active and well defined (see Hart, 1980). This study includes a review of the literature, limited field reconnaissance, and limited interpretation of aerial photographs.

SUMMARY OF AVAILABLE DATA

Koch (1933) reported that reverse movement along the Buena Vista fault had caused the collapse of casings in 23 wells in the Buena Vista oil field over a period of several years. He describes the surface trace of the fault as being marked by a well-defined scarp as much as four feet high and about 1.5 miles long (see Figure 2). The average strike of the fault is about N 75° W; the dip of the fault based on surface measurements is about 15° N, but subsurface data suggest the dip is closer to 25° N (Koch, 1933). Koch's paper includes photographs of pipelines buckled where they crossed the fault. Based on the buckled pipelines, Koch concludes that from 9 to 19 inches of shortening had occurred during a 9- to 15-year period. Also, he indicates that this movement apparently was not accompanied by any seismic events. Koch reports that numerous oil-well casing failures occurred at depths of 76 to 794 feet below the

surface. Based on the casing failures, Koch calculated that 5.8 to 15.75 inches of net slip had occurred in a 4- to 17-year period on the Buena Vista fault.

In addition to reporting movement on the Buena Vista fault, Koch indicates that movement was occurring along a few bedding plane faults in Section 1, T. 32 S., R. 23 E. Unfortunately, he does not depict these latter faults on any map (perhaps they did not extend to the surface), but vaguely refers to sixteen failures of casings at depths of 630 to 800 feet below sea level. He also indicates that the rate of movement on one of these bedding planes was about 0.12 to 0.17 feet per year.

Based on his observations, Koch concludes that the Buena Vista thrust is the surface expression of movement along a bedding-plane fault at depth. He believes historic slip is occurring along a pre-existing fault along which the underlying Plio-Pleistocene units have been offset by a substantial amount. He indicates that the earlier, pre-historic movements accompanied the anticlinal growth which created the Pleito Hills.

Wilt (1958) summarizes additional data on creep along the Buena Vista fault collected between 1933 and 1957 (Figure 2). During that 24-year period, 1.637 feet of displacement occurred (a rate of 0.068 ft/yr). Nason and others (1968) found that this slip occurs both gradually and as distinct slip events. For example, from August 28, 1967, to December 25, 1967, 2.9 mm of slip occurred at the site they monitored. On December 25, a 4-day-long creep event began during which 7.0 mm of slip occurred. The largest recorded creep event (13.4 mm) took place during a 2-hour period on 28 June 1970 (Nason and others, 1974). Nason and others (1968) suggested that slip on the Buena Vista fault may be caused by oil fluid withdrawal rather than by tectonic forces. Yerkes and Castle (1969) agreed, indicating that slip on the Buena Vista totalled 0.74 m between 1932 and 1967.*

Elliot and others (1968) briefly describe the surface trace of the fault as sinusoidal (Figure 2), and noted that no operating oil wells were located immediately north of the fault trace. Elliot and others also included the first map of the Buena Vista fault plotted on a topographic base map. Both earlier maps (Wilt, 1958; Koch, 1933) were plotted on planimetric oil-field maps.

Manning (1968; 1973; Figure 2) not only depicts the location of the Buena Vista thrust, but also shows an unnamed active fault to the north. He cites the presence of several buckled pipes as evidence that the latter fault is active. Manning also acknowledges that fluid withdrawal could have triggered the historic movement on these faults.

Movement along the Buena Vista fault has apparently continued at a great enough rate that the oil producers are not repairing wells or drilling new wells

*According to Yerkes and Castle (1969), Whitten (1961) first hypothesized that the movement was related to withdrawal of oil. Whitten's paper has not been reviewed during this study.

in the area immediately north of the fault. Abandoned wells located within producing areas (shown in light blue) are plotted in Figure 2 (California Division of Oil and Gas, 1982a; 1982b). Two small areas (uncolored on Figure 2) immediately north of the fault currently lack any producing wells. In addition, this investigator noticed several wells that are apparently shut-in in this same general area (although the Division of Oil and Gas records reportedly lack any indication that such is the case; Paul Land, oral communication, 1983). No attempt was made to review the well records on file with D.O.G.

INTERPRETATION OF AERIAL PHOTOGRAPHS

Black and white aerial photographs (U.S. Department of Agriculture, 1952) were reviewed in an effort to detect geomorphic features indicative of Holocene fault movement. Although the gross topography of the area is consistent with the existance of a thrust or reverse fault having the location and orientation of the Buena Vista fault, no fine features (e.g., sharp low scarps) indicative of recent displacement were detected. Similarly, fine features appeared lacking along the faults mapped north of the Buena Vista fault (Figure 2).

FIELD OBSERVATIONS

One afternoon in early January 1983 was spent in an effort to verify the existance of evidence of fault creep along the various faults mapped. The oil fields are a myriad of well platforms, graded roads, and pipelines that constitute a substantial "background noise" that makes detection of fine geomorphic features indicative of recent faulting difficult. No such features were evident, even immediately adjacent to manmade structures in which evidence of fault creep was clearly visible previously.

At locality 1, the concrete roadway is buckled (about 2 to 3 inches of vertical movement, north side up, is evident). Several pipes west of this buckled pavement are bowed upward. The trend on this zone of deformation is approximately N 65° W. Wells located immediately north of this apparently creeping fault appear shut-in (pumps have been removed although the "Christmas trees" are still present), although D.O.G. (1982a; 1982b) maps still indicate the wells are producing. No fault scarps were noted along the Buena Vista fault during this rapid reconnaissance. No evidence of fault creep could be verified in Section 7 (the creep locality noted on the existing SSZ map; CDMG, 1976).

At locality 2, permissive evidence of fault creep was observed in the form of a cracked and slightly offset (0.3 inches vertically, NE side up relatively), concrete-slab roadway. However, geomorphic features and additional evidence of creep-caused damage were not evident. The trend of the crack zone (approximately E-W) appeared controlled by the orientation of the slabs, and not geologic structure.

At locality 3, a paved oil-field road was cracked and appeared vertically offset, north side up, by more than 1 inch. On trend to the northwest (locality

4), former U.S. Highway 399 showed similar evidence of displacement. No scarp in the landscape was obvious on trend with these apparent creep localities, however.

At locality 5, where Manning's (1973) fault trace crosses old U.S. Highway 399, the concrete-slab pavement is spalled, buckled, and broken over a zone 60 to 70 feet wide. Less than 100 feet to the east, a 3-inch diameter pipe has been repaired, with a section of old pipe sticking up out of the ground as if it had been bowed upward due to crustal shortening. A large pipe to the west has a curious, 12-foot long, right-angle jog in it. No scarp was observed crossing the landscape at this locality.

An effort was made to detect evidence of recent (Holocene and historic) fault rupture northwest and southeast of locality 5. As indicated above, no scarp was detected at locality 5. Similarly, as indicated on Figure 2, no scarps were detected northwest or southeast of locality 5. Unlike locality 5, however, there are no oil wells, pipelines, or paved roads in the vicinity of Manning's (1973) trace northwest and southeast of locality 5; thus, evidence of fault creep is also lacking.

CONCLUSIONS

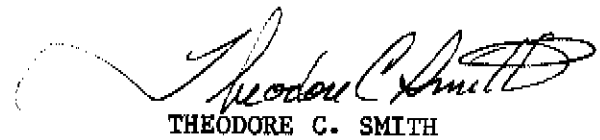
Based on published data, it appears that fault creep has occurred along the Buena Vista fault and two related bedding-plane faults. It also appears that this movement has been aseismic and probably results from fluid withdrawal.

Although Manning (1973) depicts a creeping fault as locally extending outside the present Special Studies Zone (CDMG, 1976), no evidence was detected in the field that would verify that such is the case. Manning was not available to describe the evidence that caused him to delineate the fault as he did. It also appears that historically active faults verified during this brief study all lie within the existing SSZ's.

There is no evidence to indicate that these historically active faults were previously active during Holocene time, although Kock (1933, p. 697 and 700) implies that Quaternary faulting occurred along the Buena Vista thrust.

RECOMMENDATIONS

Based on the data summarized herein, modification of the Special Studies Zones map for the Taft 7.5-minute quadrangle does not appear essential. Although the location of the Buena Vista fault may differ slightly from that depicted on the SSZ map (based on the literature reviewed), the zones are still functional. Therefore, no modifications are recommended. A more detailed analysis may be appropriate when resources permit.



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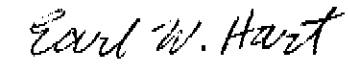
Reviewed; recommendation approved.



EARL W. HART
C.E.G. 935
May 30, 1985

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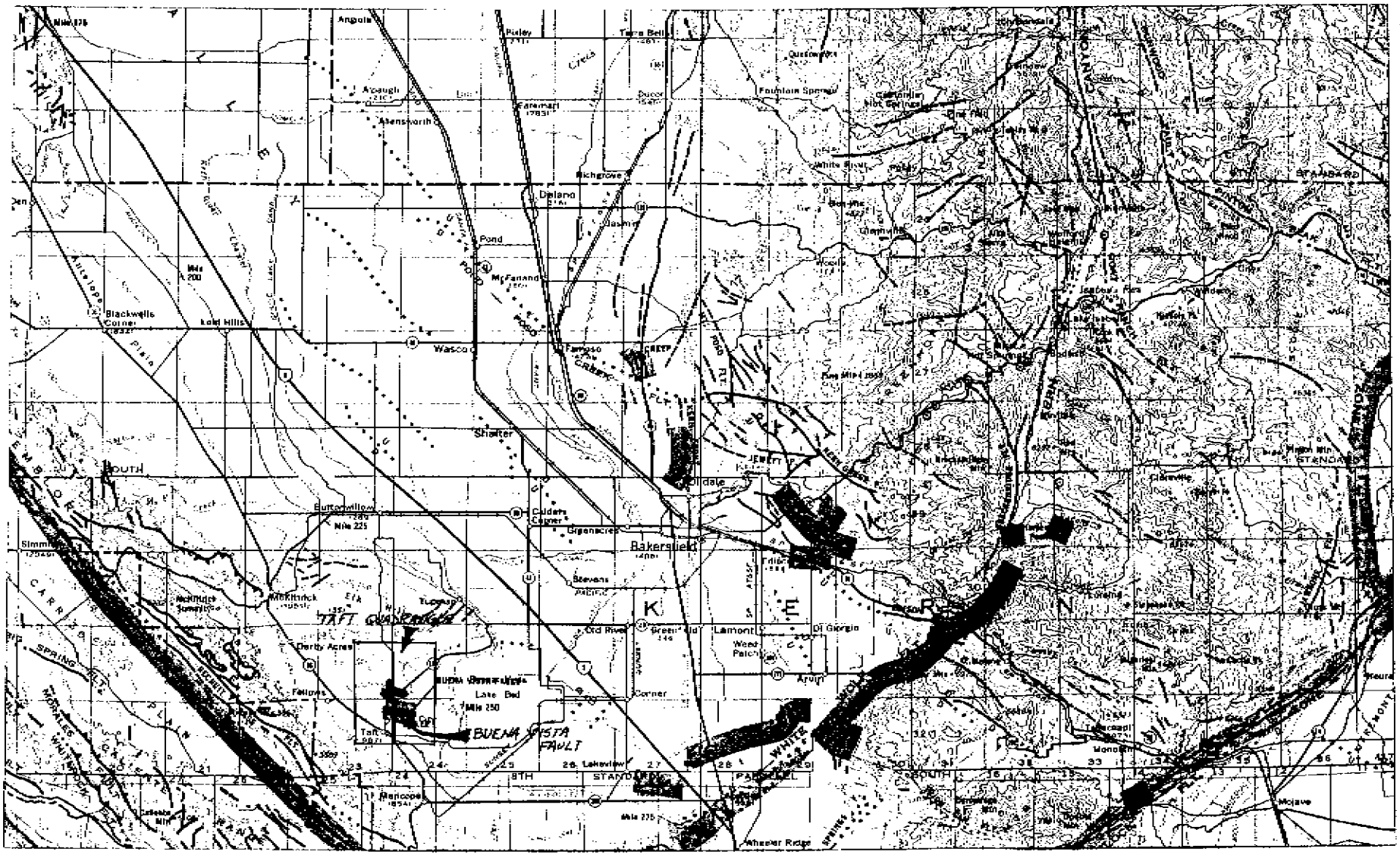

FER-163, Figure 1. Location of the Buena Vista fault in the Taft quadrangle (Jennings, 1975, modified).